GEA-2400

# • • PLANNING • •
# ADEQUATE STREET LIGHTING

## GENERAL ELECTRIC

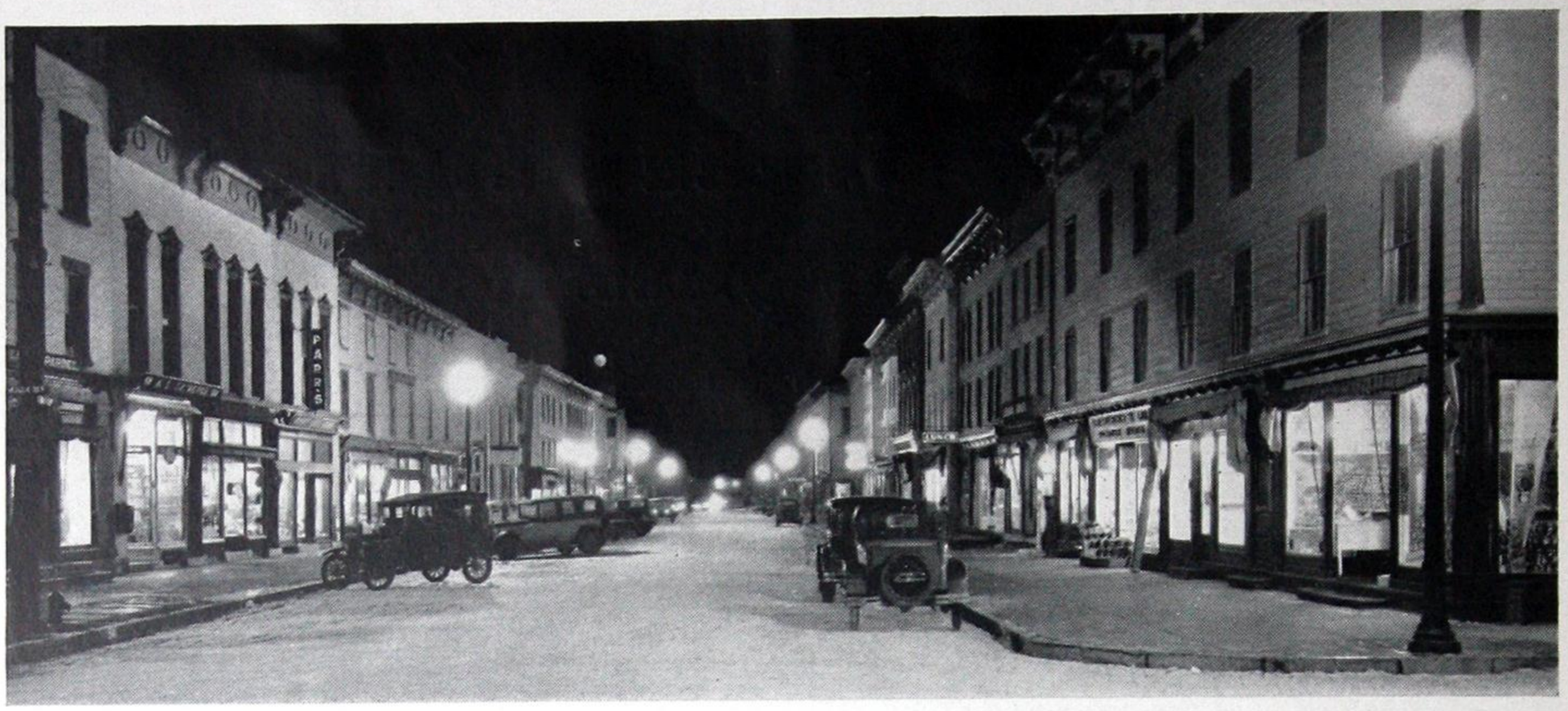
Detroit's Washington Boulevard, an excellent example of "white way" lighting in a large city

THIS year some $98,000,000 will be spent to provide lighting for the streets of this country. All of this amount, and more, is justified. But much, perhaps even most, of our lighting today is inadequate for our needs—it is often poorly distributed, ineffectively applied, or incorrectly planned. In order to help cities get their money's worth from street-lighting investments, this publication is presented by General Electric to city officials and others who are anxious to obtain full value from their limited lighting budgets.

To understand how to plan and judge street lighting, we must first understand what it is supposed to accomplish. This will vary in degree, of course, with the size of the city and town and with the type of business that is carried on. However, three classifications can cover the important objectives:

**Safety** . . . It has been definitely proved that night traffic accidents and crime can be cut in half by properly applied street lighting. Since more than one half of all fatal traffic accidents and three quarters of crime losses now take place at night, it should be evident that street lighting plays a very important part in a campaign against theft, violence, and death.

**Business** . . . The sales and profits of stores, hotels, theaters, and restaurants in downtown sections are noticeably affected by street lighting. The better the lighting, the larger the crowds on the streets at night, and the better the business. To a greater extent than most people realize, these



A well-lighted business section in a small town—ornamental and very effective

various stores and shops are affected by the lighting of streets leading to the business section—residential streets and boulevards, traffic arteries, and highways leading into the city.

**General . . .** Lighting plays an important part in the creation and building of civic pride; it stands as visible evidence of the progressive spirit of a city. It reflects the attitude of the city administration, and many an election has been swung over to the side that has been able to point, with just pride, to the street lighting it has installed, or that it plans to put in.

Lighting is a very effective way of influencing the growth of a city and of assisting in the carrying out of zoning plans. Lighting can play an important part in building up suburbs, in rerouting traffic over less crowded streets, and in influencing the location of stores, community centers, and even factories and large plants.

Finally, lighting brings a sense of security to citizens. Women, in particular, are grateful for the greater security of well-lighted streets—of residential sections made cheerful and safe by lighting.

### *Types of lighting needed*

**In downtown sections** lighting must not be confined to the streets themselves. Light for safety and ease of driving is important, of course; but also important is light on building fronts, signs, walks—every place that will add to the cheerfulness of the business and shopping areas. Luminaires should be selected which are pleasing in appearance and which adequately light everything between the building lines. Except in the smallest towns, wiring should be underground. Lighting standards should be located relatively close together, with spacing often as short as four times the height of the standard.

**In residential sections,** on the other hand, too much light on buildings is objectionable. Lighting should be more or less confined to the street, where it is needed for safety and convenience. Enough light on lawns and between houses is necessary to discourage prowlers and to illuminate walks and steps, but objectionable glare should be suppressed, and bright lamps should be shielded from windows. Luminaires should be selected which are pleasing in appearance and which are efficient in their distribution of light. Again, because of the better appearance, underground wiring is preferable in larger cities. However, ornamental brackets and luminaires which can be mounted on existing distribution poles are available. Since the overhead wire is often hidden in the trees, such a less-expensive installation may present a satisfactory and pleasing appearance, the brackets and fixtures alone being visible.

**On traffic arteries** and on highways outside the

city limits, lighting is intended primarily for safety. It must enable motorists to see pedestrians and obstacles at a safe stopping distance. Consequently, the appearance of the luminaire makes little difference; overhead wiring, being less expensive, is almost universally used. Relatively large lamps and long spacings are recommended for most installations, and mounting heights should be 22 to 30 feet.

We see and locate objects in two ways: by seeing the light reflected from the object, and by seeing the object stand out as a clearly outlined black shape against a lighted background. When we see by the headlights on our car, we must depend on the first method. With dark objects, particularly people dressed in dark, light-absorbing clothes, it may be absolutely impossible for the best eyes to see a man more than 150 feet away. With street or highway lighting, we see largely by the second method—by silhouette of the object against the light or against the lighted road. As a result, even poor vision can distinguish a man a quarter of a mile away on an adequately lighted road, can clearly see a car or large obstacle half a mile away—silhouetted against the road which is reflecting the long line of overhead lights.

### *The I. E. S. Code of Street Lighting*

The Illuminating Engineering Society, whose members include well-known lighting authorities, has made a careful study of street-lighting requirements. Its street-lighting committee periodically collects and collates the opinions of all experts on this subject. The published report, the I.E.S. Code of Street Lighting, is recognized as the standard of good practice: minimum values of illumination levels, lamp sizes, mounting heights, spacings, etc.

### *General Electric's Classification of Streets*

These established minimum requirements of good street lighting, as given by the Code, are based on classification of streets by traffic count—the average and maximum numbers of cars passing over a street, and the character of the street. Such counts are not always available; therefore, General Electric engineers, who are constantly working on this type of problem, have developed tables which classify streets according to type and to size of city. These were developed as an aid to our engineers, and of course cannot be taken as rules which *must* be followed. Exceptions will always occur; but in general the recommendations will be found to be excellent. The low figures represent minimum values which should be used on narrow streets; the high values conform to the best practice on wide streets. Local conditions will dictate the position between upper and lower limits to be assigned to any particular street. When necessity demands that a street be lighted to a value below that recommended, provision should be made during the installation for future increase in illumination, so that the lighting can be brought up to the minimum standard without undue expense.

### *Street-lighting Equipment*

While it is not the purpose of this publication to list and describe street-lighting equipment itself, it may be well to say just a word about

**An ornamental upright luminaire and standard in Washington, D. C. Large cities use this type of lighting on boulevards and often in the better residential districts; smaller towns use it in business districts**

# GENERAL RECOMMENDATIONS FOR LIGHTING

## CITY STREETS

### Primary Business Streets . . . *Ornamental Lighting, Wiring Underground*

| | Classification by Population | | |
|---|---|---|---|
| | More than 100,000 | 30,000 to 100,000 | Less than 30,000 |
| Lumens of Lamps | 15,000 to 45,000 | 10,000 to 25,000 | 6000 to 15,000 |
| Lamps per Standard | 2 | 1 or 2 | 1 or 2 |
| Arrangement of Standards | Opposite on wide streets—staggered on narrow | | |
| Feet of Street per Standard | 50 to 75 | 40 to 75 | 40 to 75 |
| Lumens per Linear Foot | 600 to 2000 | 300 to 800 | 120 to 400 |
| Height of Upright Unit | 20 to 30 ft | 18 to 25 ft | 15 to 20 ft |
| Height of Pendent Unit | 25 to 30 ft | 20 to 30 ft | 20 to 25 ft |

### Secondary Business Streets . . . *Ornamental Lighting, Wiring Underground*

| | | | |
|---|---|---|---|
| Lumens of Lamps | 15,000—25,000 | 10,000—15,000 | 6000—10,000 |
| Lamps per Standard | 1 | 1 | 1 |
| Arrangement of Standards | Opposite on wide streets—staggered on narrow | | |
| Feet of Street per Standard | 50 to 75 | 40 to 75 | 40 to 75 |
| Lumens per Linear Foot | 300 to 500 | 150 to 300 | 60 to 150 |
| Height of Upright Unit | 15 to 18 ft | 15 to 18 ft | 15 to 18 ft |
| Height of Pendent Units | 20 to 25 ft | 20 to 25 ft | 20 to 25 ft |

### Traffic Arteries . . . *Ornamental or Semiornamental Lighting, Wiring Underground and Overhead*

| | | | |
|---|---|---|---|
| Lumens of Lamps | 6000 to 15,000 | 6000 to 15,000 | 2500 to 10,000 |
| Arrangement of Lamps | Staggered | Staggered | Staggered |
| Feet of Street per Standard | 200 to 500 | 200 to 500 | 200 to 500 |
| Lumens per Linear Foot of Street | 20 to 50 | 15 to 50 | 10 to 30 |
| Height of Pendent Unit | 20 to 25 ft | 20 to 25 ft | 18 to 25 ft |

### Residential Streets—Not Thoroughfares . . . *Ornamental and Semiornamental Lighting*
*Wiring Underground and Overhead*

| | | | |
|---|---|---|---|
| Lumens of Lamps | 2500 to 6000 | 2500 to 6000 | 2500 to 6000 |
| Arrangement of Standards | Staggered | Staggered | Staggered |
| Feet of Street per Standard | 60 to 150 | 75 to 200 | 100 to 200 |
| Lumens per Linear Foot | 20 to 40 | 15 to 30 | 10 to 20 |
| Height of Upright Unit | 13 to 18 ft | 13 to 18 ft | 13 to 18 ft |
| Height of Pendent Unit | 18 to 25 ft | 18 to 25 ft | 18 to 25 ft |

### Industrial and Warehouse Section Not on Traffic Arteries . . . *Pendent Lamps*
*Usually Overhead Wiring*

| | | | |
|---|---|---|---|
| Lumens of Lamps | 6000—15,000 | 6000—10,000 | 6000 |
| Lamps per Standard | 1 or 2 | 1 | 1 |
| Arrangement of Standards | Staggered except on very wide streets | | |
| Feet of Street per Standard | 75 to 150 | 100 to 150 | 100 to 150 |
| Lumens per Linear Foot | 60 to 200 | 40 to 100 | 40 to 60 |
| Height of Upright Unit | 15 to 18 ft | 15 to 18 ft | 15 to 18 ft |
| Height of Pendent Unit | 20 to 25 ft | 20 to 25 ft | 20 to 25 ft |

**Outlying districts and partially developed sections** with little traffic are usually best lighted by fairly large-sized pendent units at long spacings (200 to 300 ft) or more numerous small units where there is tree interference. Units are usually installed as the demand arises, so that it is hardly worth while to attempt to make the installation conform to a given standard.

## HIGHWAYS OUTSIDE CITY LIMITS

| | Incandescent Lamps | | Sodium Lamps | |
|---|---|---|---|---|
| | 2 Lanes | 3 Lanes | 2 Lanes | 3 Lanes |
| ***Light-colored or darker, oil-polished pavements. Pendent lamps, overhead wiring.*** | | | | |
| Lumens of Lamps | 4000 | 4000 | 10,000 | 10,000 |
| Arrangement of Lamps | One side | Staggered | Staggered | Staggered |
| Feet of Street per Standard | 125 | 125 | 200–250 | 200–250 |
| *Lumens per Sq Ft of Road Surface | 0.60 | 0.51 | 0.38–0.48 | 0.35–0.43 |
| Height of Pendent Unit | 25 ft | 25 ft | 25 ft | 25 ft |

* For pavements permanently light in color, the I.E.S. Code calls for 0.2 to 0.5 lumen per square foot of road surface; for darker pavements, oil-polished, the Code calls for 0.3 to 1.0 lumen.

**Four-lane highways** and wider, and highways with a dull, black pavement require special treatment and more light. Refer to the G-E Illuminating Laboratory, Schenectady, N. Y., for recommendations.

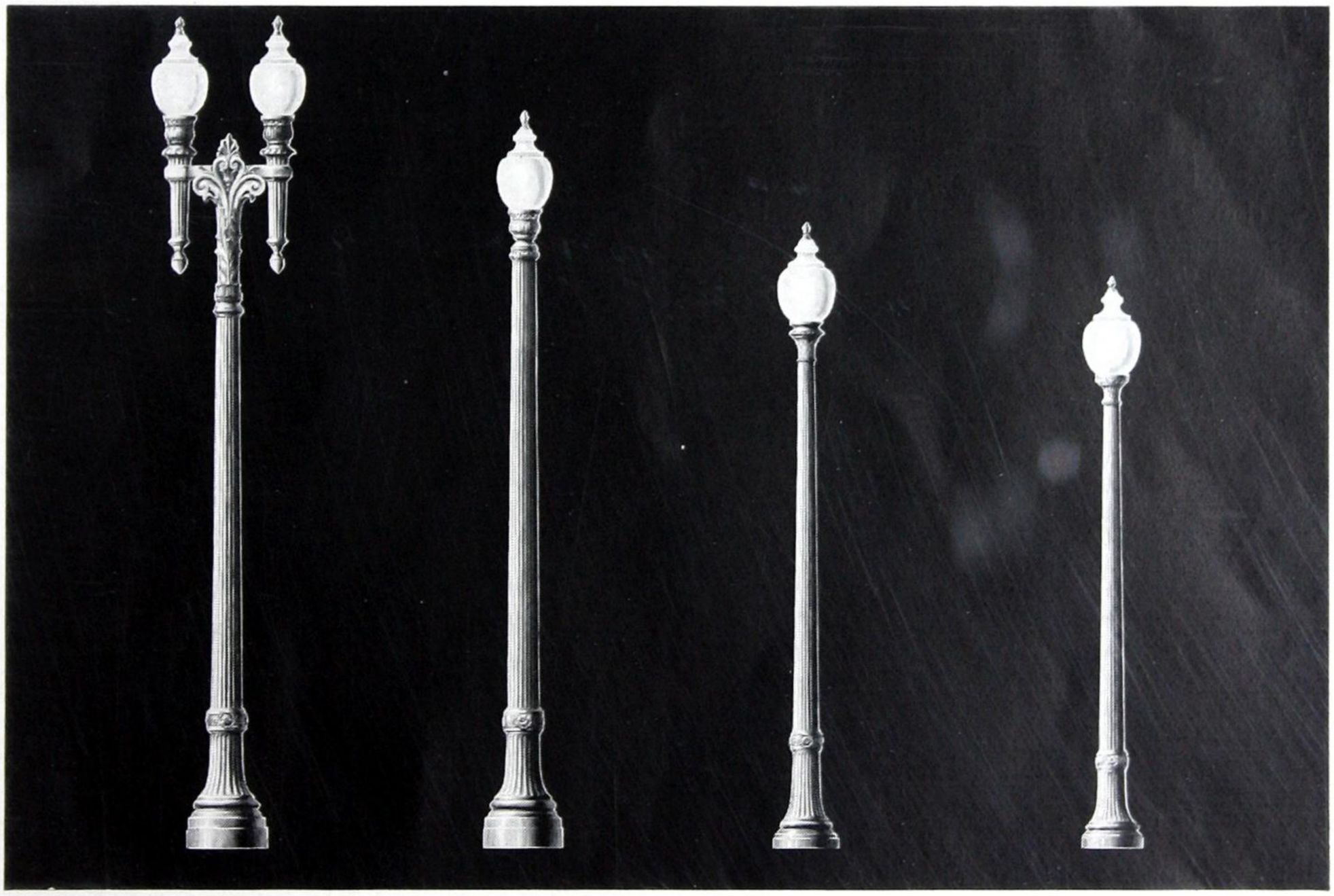
different types. Street-lighting equipment is broadly classified as upright and pendent.

For ornamental lighting, as in business districts, the choice between upright and pendent is largely one of appearance. Highest utilization efficiency—i.e., the greatest amount of light on the road for a given size of lamp—is usually not required. The luminaire is expected to throw some light on buildings, trees, and general surroundings.

For semiornamental and utilitarian lighting, efficiency becomes more important, and in general, pendent or suspension luminaires, which possess more efficient light-control characteristics, should be chosen.

Upright luminaires are selected according to appearance—how the complete assembly harmonizes with surrounding architecture. Hundreds of combinations of standards or poles, shapes and styles of glassware, and fittings, such as ribs, canopies, etc., are possible. All are approximately equally efficient and satisfactory, and differ only in appearance. It is possible and usually desirable to select one general style, and then specify the glassware, standard, and fittings to conform to this style. When this is done, all luminaires, regardless of size and number of lamps and height of standard, will present a uniform appearance, both by day and by night. Glass refractors, which intercept much of the stray light and direct it downward and along the road, should be included on certain classes of streets, such as residential streets and traffic arteries. Through their saving of this otherwise wasted light, they more than justify the small additional cost.

In the semiornamental and strictly utilitarian luminaires, different conditions exist. Here, designs have been developed only to be superseded many times during a period of years by better designs made possible through new materials, better manufacturing, and engineering advancement. Modifications have been necessary, here and there, to meet some specific operating condition. Thus



By selecting one style from the hundreds available, cities may keep all their street-lighting luminaires and standards uniform in appearance. This is only one of many "families" of designs

have come about literally thousands of different combinations to meet perhaps half a dozen different needs. As a rule, only one or two of these combinations will do the best job at the lowest cost.

To mention four examples of these new, highly efficient designs: the General Electric Form 79R for residential streets; the Form 72 with an Asy-radial-wave reflector for outlying secondary traffic arteries; the sodium luminaire for general highway lighting; and the Form 86 highway luminaire for narrow highways where 125-foot spacing is possible. The photographs shown in this publication are all of modern, up-to-date luminaires.

### *Street Lighting*

Every city and town should have a street-lighting plan—a plan showing the type of equipment, intensities, mounting heights, etc., for every street or type of street. This plan should be reviewed every few years, or before any major purchases are made, so that the city can take advantage of new developments in equipment, and new standards of lighting. Where existing equipment does not conform to modern-day standards, a program of modernization should be laid out; new equipment should be installed according to the revised plan—not according to selections made years before. In this way, over a period of years the street-lighting installation will be improved by conforming more closely to the ideal plan.

### *How to SET UP a Plan*

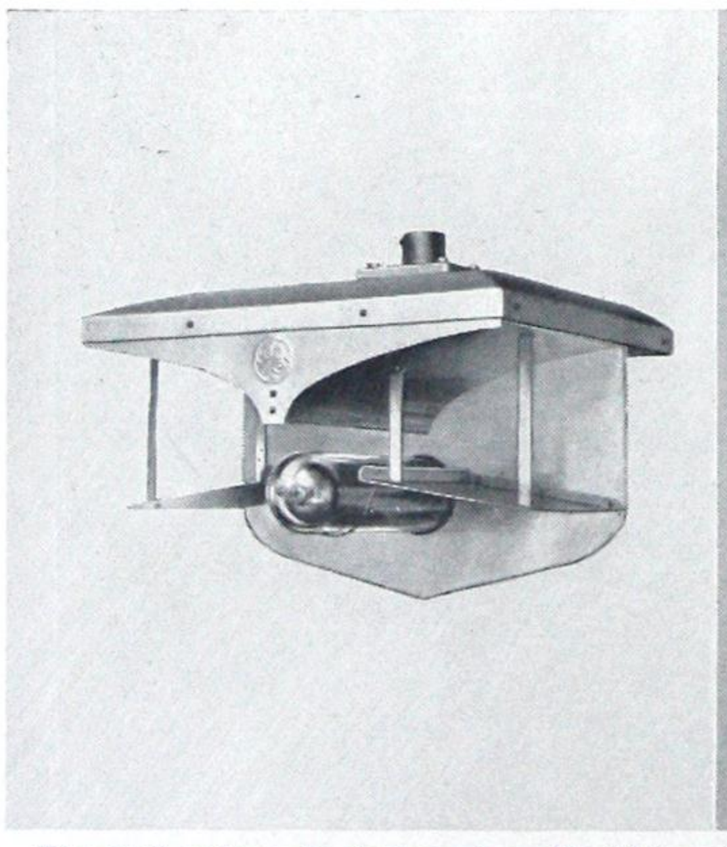
The first step in designing a lighting system is to zone the city. Obtain a large map of the entire city and chart the streets in accordance with the following subdivisions:

| | |
|---|---|
| I | Primary business streets |
| II | Secondary business streets |
| III | Primary traffic arteries |
| IV | Secondary traffic arteries |
| V | Residential streets and park drives |
| VI | Highways and undeveloped sections |

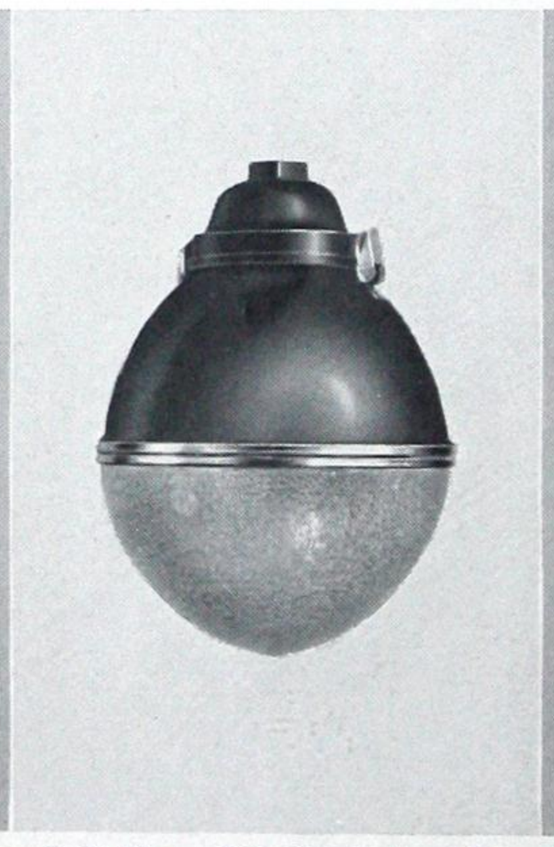
Some classifications may include manufacturing and wholesale districts, but these can usually be classed under traffic arteries or secondary business streets.

If a city zoning plan is available, this classification work is greatly simplified; if not, the lighting map must necessarily become the city plan. This is such an important step that expert advice is well worth while.

After the size of lamps, mounting heights, and spacings have been determined by the I.E.S. Code, or by the tables in this publication, the next step is to select the equipment. Manufacturers of lamps and lighting equipment have spent huge sums in preparing exhibits, both in full size and in minia-

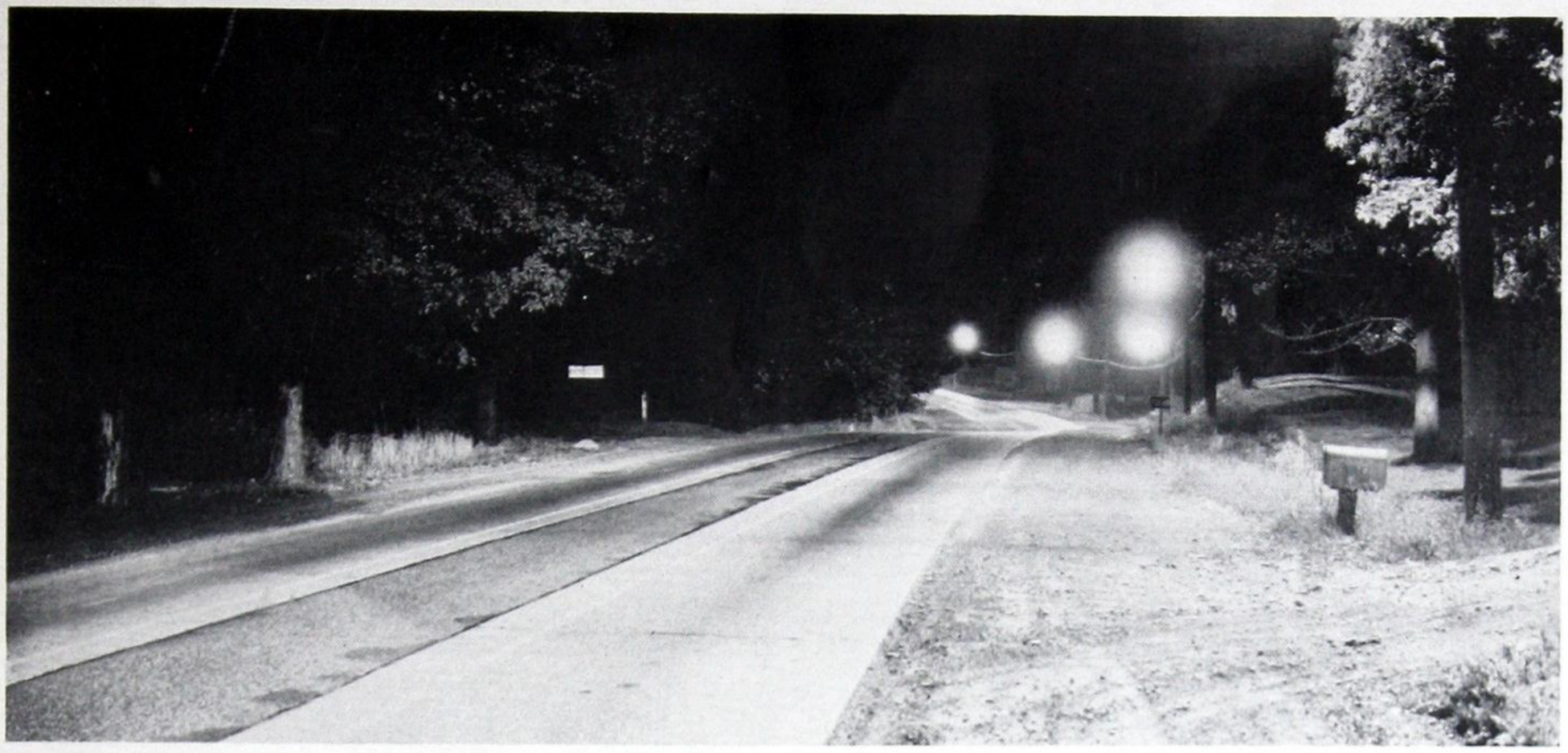


The G-E sodium luminaire—for wide highways and for 250-ft spacing on narrow ones. Provides a soft, golden-orange light which is restful and pleasing. The lamp produces 10,000 lumens of light—three times as much light as an incandescent lamp of the same wattage



The G-E Form 79R luminaire. Does by far the best lighting job ever done in residential sections or on traffic arteries. The biggest feature is 90-per-cent more light on the pavement than is provided by any comparable luminaire of older design. Since the Holophane refractor is permanently sealed on the reflector, maintenance is reduced. Glare is suppressed, since the lamp filament is up in the reflector, not below it

The G-E Form 86 highway luminaire—for two- and three-lane highways, 125-ft spacing. Gives lighting that appears smooth and uniform to the motorist, and at the same time suppresses glare by shielding the lamp at 10 degrees below the horizontal



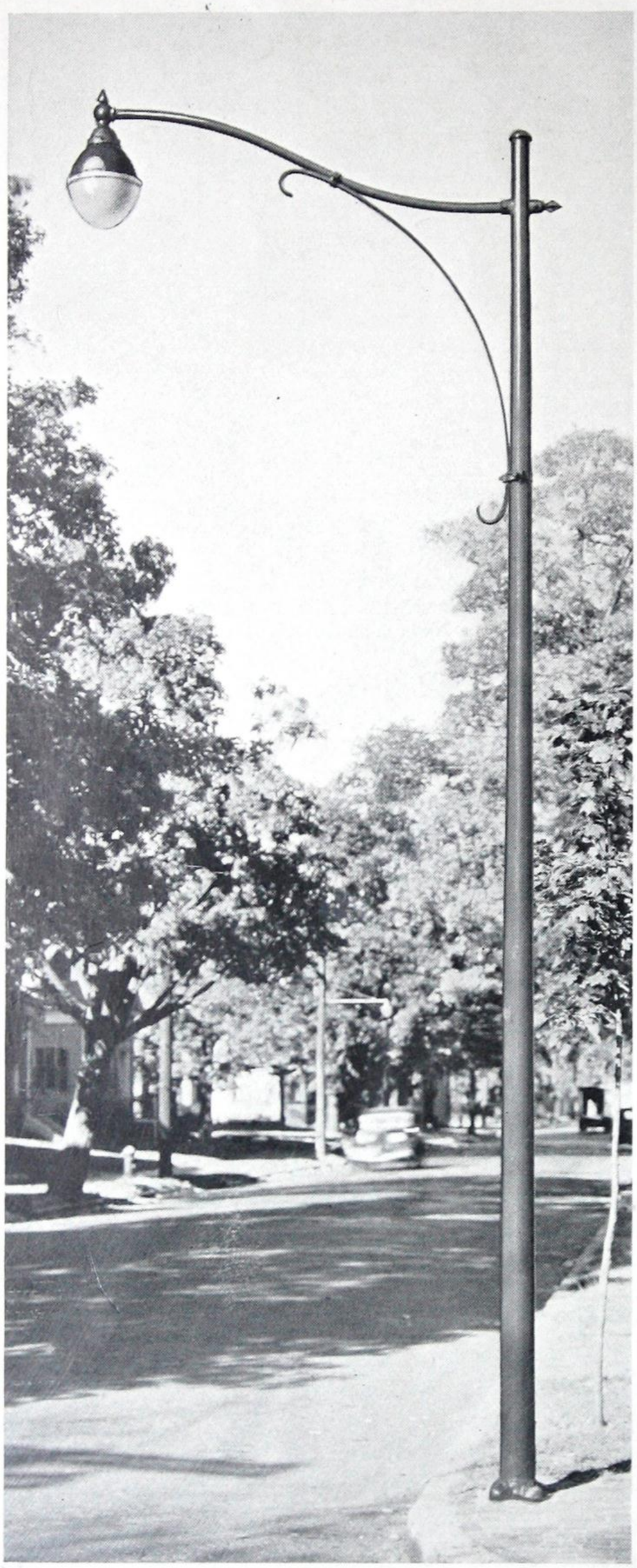
**Sodium lighting, on the highway, produces this excellent illumination. With the soft golden-orange light, visibility is high, glare is suppressed, and the entire effect is attractive and restful. Safety to motorist and pedestrian is the important consideration**

ture, of street-lighting equipment. In a few minutes one can see the principles of street lighting demonstrated, and examine modern equipment. Where it is impossible to visit such a demonstration, consult with lighting engineers and specialists of recognized, successful manufacturers. Though planning for the future may seem unnecessary, it is actually the most economical way of obtaining good lighting.

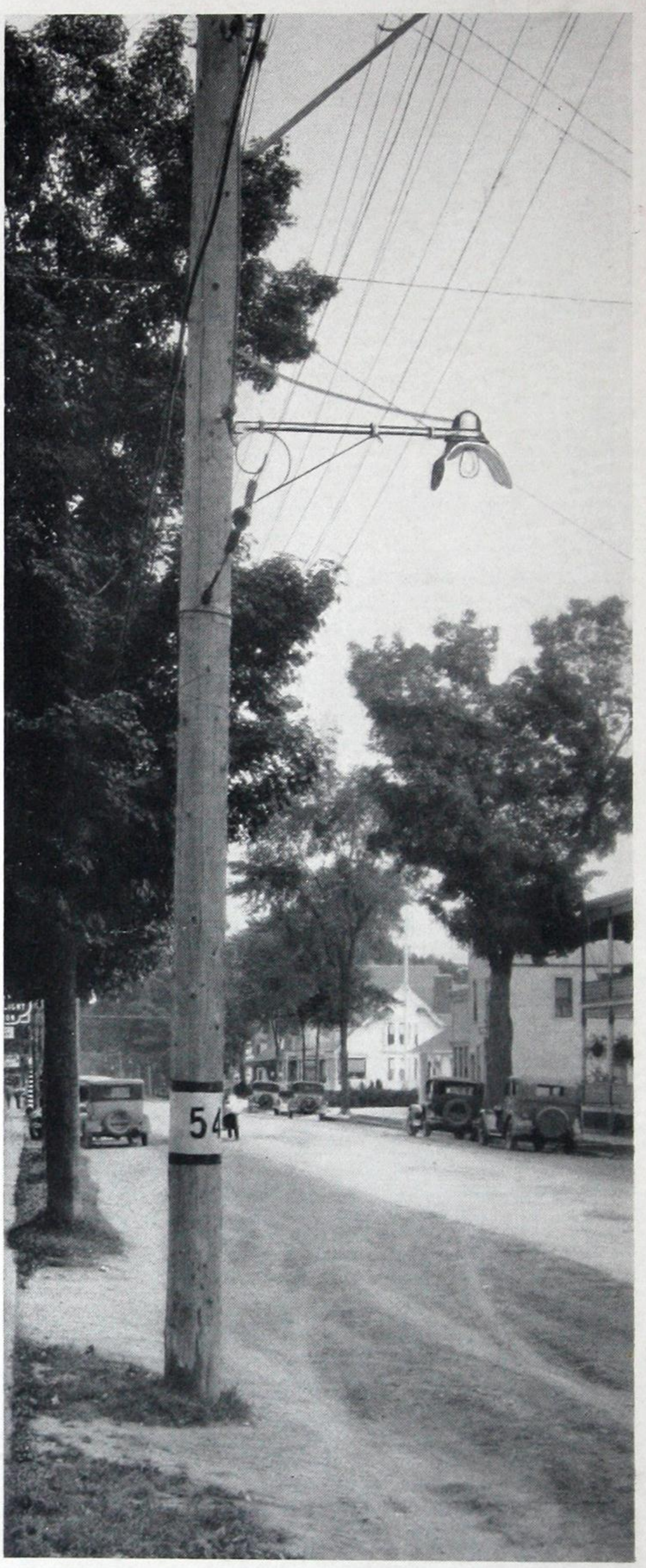
Above all, remember that good lighting is important—its cost is inconsequential compared with the savings it will bring. Investments of from five to ten dollars per capita may be necessary to remodel and modernize a city's lighting; no progressive city should spend less than two dollars per capita, annually, for street lighting. The direct savings, from fewer accidents and less crime, will equal two to three times this amount. Don't make a laboratory of your city to see how little lighting is needed. Other cities have already tried it and proved to their satisfaction that:

"We pay for good lighting whether we get it or not. With inadequate lighting, we pay in accidents, crime, and death."

**One of the most unusual and attractive highway-lighting installations ever made uses the G-E Form 86 luminaire. Visibility, and therefore safety, is excellent. The lamp is shielded by the reflector so as to suppress glare. Light on the pavement is smooth and uniform**



For residential sections in cities of any size, this combination of G-E Form 79 luminaire and a slender, inexpensive steel standard is ideal. The appearance is pleasing, the efficiency high, and the light distribution excellent




For outlying sections—wherever low cost is more important than appearance—the Form 72 luminaire, with its Asy-radial-wave reflector should be used. Installation and maintenance costs are exceedingly low; efficiency is high

**GENERAL ELECTRIC**

**SCHENECTADY, N. Y.**

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